Thermogravimetric Investigations of Human Tooth Hard Tissues in Thermocycling

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The thermophysical properties of biological materials, and in particular human tissues, are still not well known. The reasons for that are difficulties in obtaining the adequate specimens and complicated composition and structure of the materials, which makes the measurements more difficult. This is also the case when human tooth hard tissues are considered (comp. [1], [2]). However, many modern medical therapy methods are based on thermal treatment in which the thermophysical properties are essential to mathematical modeling involved in the therapy planning.

Having that in mind, we started a program of thermophysical properties of hard tooth tissue investigation some years ago. Some of the results differ from the data presented in the literature. This concerns in particular the specific heat data that were gained in thermocycling experiments [1]. Because of the fact that differences were substantial and the observed thermocycling effects were non-typical, the results needed to be validated and the discrepancies explained.

The previous experiments indicated that the dentine specific heat characteristic converges to those of enamel [1]. That fact together with observations of the thermal history effects in dentine and enamel suggested that the revealed phenomena were connected with specific porous and microfibrous structure of the dentine. In order to verify that assumption, additional thermogravimetric measurements have been performed. The SETARAM TG apparatus has been applied. The measurements have been carried out on the same specimens that were used before in DSC experiments. Thermocycling conditions similar to the previous ones have been preserved. The results of these measurements are described and discussed in the present paper. The measurements have revealed repeated mass loss accompanying every heating process. The losses have been much more significant for the dentine than for enamel. In view of the porous dentine structure it suggests the decisive role of moisture evaporation and absorption. On the basis of the obtained results, using also DSC data [1], some quantitative calculations have been performed. A necessity for the porous hard tissue data correction based on complex thermophysical properties investigation has been concluded.

[1] S. Zmuda, P. Zaborowski, and A.J. Panas, *Microcalorimetric investigations of human hard tissues in thermocycling,* 26th ITCC/14th ITES, Cambridge, Massachusetts, 6-8 August 2001.
[2] A.J. Panas, S. Zmuda, J. Terpiowski, and M. Preiskorn, *International Journal of Thermophysics* **24** (3), 837 (2003).